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Authorized Signature:

Mary C. Gawlicki
(Signature)

Mary C. Gawlicki
President
Corporate Translations, Inc.

May 23, 1996

"Subscribed and sworn to before me
this 23rd day of May, 19 96 "

Ruth P. Wilson

Notary Public

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(72) Inventor: Masaaki Harubara, Matsushita Electric Industrial Co., Ltd., 1006 O-aza Kadoma, Kadoma-shi

(72) Inventor: Tsutomu Niita, Matsushita Electric Industrial Co., Ltd., 1006 O-aza Kadoma, Kadoma-shi

(72) Inventor: Yoshio Nakatani, Matsushita Electric Industrial Co., Ltd., 1006 O-aza Kadoma, Kadoma-shi

(72) Inventor: Tetsu Tamura, Matsushita Electric Industrial Co., Ltd., 1006 O-aza Kadoma, Kadoma-shi

(71) Applicant: Matsushita Electric Industrial Co., Ltd., 1006 O-aza Kadoma, Kadoma-shi

(74) Representative: Toshio Nakao, Patent Attorney, and 1 Other

Specification

1. Title of the Invention

A method for manufacturing a disc substrate.

2. Claims

(1) A method for manufacturing a disc substrate, characterized by the fact that in injection molding or injection compression molding of a disc substrate, a stamper is installed on the molding surface of the core of the metal mold with a sheet interposed.

(2) The method for manufacturing a disc substrate of Claim 1, characterized in that the sheet is a metal sheet.

(3) The method for manufacturing a disc substrate of Claim 2, characterized in that the metal sheet is selected from among aluminum and copper.

(4) The method for manufacturing a disc substrate of Claim 1, characterized in that the sheet is a synthetic resin sheet.

3. Detailed Description of the Invention

Fields of Industrial Use

The present invention relates to a method for manufacturing disc substrates for optical discs, optomagnetic discs, etc.

Prior Art

Manufacturing and development of substrates for video discs, compact discs, recordable and erasable

optical discs, and optomagnetic discs is carried out by means of injection molding or injection compression molding. Molding of the disc substrate is carried out by thin-walled precision molding, with vital factors including increasing precision of metal molds, development of resin materials, and development of molding conditions such as metal mold temperature, cylinder temperature, injection pressure, and injection rate. Numerous factors are required in the case of substrates for optical-type discs, and among these, important considerations are that birefringence, caused by molecular chain orientation and residual distortion during molding of molded products, must be small, and that the transferability of guide channels for signal bits or tracking must be favorable. These factors can be improved by means of developing resin materials (which must have a low photoelastic coefficient and favorable melt flow properties) and setting molding conditions, e.g.: (1) increasing the cylinder temperature to increase flow properties of the resin material; (2) increasing the metal mold temperature; (3) keeping injection pressure as low as possible; and (4) making the injection rate as fast as possible.

However, there are limitations on the individual conditions mentioned under (1)-(4) above, e.g., in the

case of (1), the problem of thermal deterioration of the resin material, and in the case of (2) the problem of prolongation of cooling time, preventing cycle shortening and causing warping of the disc substrate. In the case of (3), birefringence is improved, but the internal pressure of the resin drops, making transfer of the signal poor. In (4), there is a tendency toward excess filling, making control difficult, and it has been difficult to find a complete solution for these problems (Plastic Age, Mar. 1984, pp. 103-106).

On the other hand, concerning the structure of the metal mold, as is the case for ordinary molded products, attention has been focused only on speeding up the cooling and hardening rate of the molten resin as much as possible in order to improve productivity. Fig. 3 shows a schematic sectional diagram of a conventional metal mold for molding of disc substrates (Japanese Unexamined Patent Application No. 83-151223).

In Fig. 3, 1 is a fixed die plate, 2 is a mobile die plate, 3 is a fixed side core, 4 is a mobile side core, 5 is a stamper tightening component, 6 is a stamper pressing ring, 7 is a cavity, 8 is the stamper, 9 and 10 are grooves for cooling medium for cooling the molten resin, 11 is a spray component, and 12 is an injection cylinder.

Concerning the disc substrate, for example, in injection molding, in the case of the metal mold shown in Fig. 3, the molten resin injected from the injection cylinder 12 passes through the spray component 11 and fills the cavity. In the die plate on one side of this metal mold (mobile die plate 2 in Fig. 3), a stamper 8 which has guide channels for signal bit or tracking purposes is held in place using a stamper tightening component 5 on the inner periphery and a stamper holding ring 6 on the outer periphery. In this type of configuration, as the cavity fills with molten resin, the pressure inside the cavity increases and signal transfer is carried out, and at the same time, the stamper 8 is brought directly into contact with the mobile side core 4, and hardening of the molten resin takes place. This type of injection has the effect of eliminating anything between the stamper and the core so that direct contact can occur in order to remove heat from the resin material filling the metal mold as rapidly as possible, thus shortening the cooling period until mold opening occurs.

However, in molding the disc substrate, in order to improve the aforementioned birefringence, signal bits,

and transferability of the guide channels, it is preferable to remove the stamper 8 from the molten resin until the internal cavity pressure of the injected molten resin has been transferred to a sufficient degree. The reason is clearly that in ordinary molding, because the metal mold temperature is set at a level approximately 10-40°C lower than the thermal deformation temperature, injection causes the surface layer of the resin material, which is in contact with the cavity surface of the metal mold, to immediately harden, decreasing transferability and causing force to be exerted during hardening, causing residual deformation and resulting in poor birefringence.

Problems to be Solved by the Invention

The purpose of the present invention is to solve the above-mentioned problems of past technology in cooling of the injected molten resin inside the cavity by providing a method for manufacturing disc substrates which makes it possible to obtain substrates for optical discs, optomagnetic discs, etc., which show favorable properties with respect to the vital characteristics of birefringence and transferability.

Means for Solving Problems

In the method for manufacturing disc substrates of the present invention, the aforementioned purpose is achieved by means of a configuration in which, in injection molding or injection compression molding of disc substrates, a stamper is installed on the molding surface of the core of the metal mold with a sheet interposed.

Action

In the method for manufacturing a disc substrate of the present invention, when the injected molten resin flows into the cavity of the metal mold, because a sheet is interposed underneath the stamper, thermal conduction from the molten resin to the cooling medium for cooling the molten resin placed in the metal mold is decreased, the rate of cooling of the molten resin is slowed, and apparently, the cylinder temperature increases and the fluidity of the molten resin is improved, obtaining the same effect as if the metal mold temperature had been increased, and together with increasing transferability, a vital property for the disc substrate, the rate of hardening is slowed, and by applying power before hardening has proceeded, deformation is reduced, thus improving birefringence.

Practical Example

The following is an explanation of the present invention by means of a practical example, with reference to the figures. Fig. 1 shows a sectional diagram of a metal mold for manufacturing disc substrates according to the present invention. This corresponds to the conventional example shown in Fig. 3. In this practical example, a sheet 13 is placed between the stamper 8 and the mobile side core 4. The sheet may be composed of metal or synthetic resin. In the case of metal, as the sheet is placed between a nickel stamper and a copper mobile side core, one may use a metal having low hardness such as aluminum or copper, and such metal sheets are machined to the same dimensions as the stamper in both internal and external diameter. Moreover, in the case of synthetic resin sheets, the sheet should have the necessary adiabatic properties, with an example being a polyimide film.

Fig. 2 is a partial sectional expanded diagram showing the configuration of the stamper 8, sheet 13, and mobile side core of Fig. 1. As a result of this configuration, hardening of the molten resin is slowed, making it possible to manufacture a material having outstanding birefringence and transferability. Moreover, cooling time is not lengthened by interposing this sheet.

Effect of the Invention

As shown in the above explanation, in the method for manufacturing a disc substrate of the present invention, as a stamper is installed on the molding surface of the core of a metal mold with a sheet

interposed in injection molding or injection compression molding of disc substrates, a product having improved birefringence and transferability is obtained, and this is particularly noticeable when a synthetic resin sheet having adiabatic properties is used. In past technology the stamper surface and the mirror surface of the core surface were directly in contact for each shot, but in the present invention, as a sheet is interposed, this has the secondary effect of extending the life of the stamper and the metal surface of the core of the metal mold. Moreover, as the tiny indentations on the surface of the stamper are also absorbed to a certain extent by the sheet, this has the effect of preventing these indentations from being transferred to the surface of the disc substrate.

4. Simplified Explanation of the Figures

Fig. 1 shows a practical example of the present invention, Fig. 2 shows a partial expanded sectional diagram thereof, and Fig. 3 shows a conventional example.

1: Fixed die plate, 2: Mobile die plate, 3: Fixed side core, 4: Mobile side core, 5: Stamper tightening component, 6: Stamper pressing ring, 7: Cavity, 8: Stamper, 9, 10: Channel for cooling medium to cool the molten resin, 11: Spray component, 12: Injection cylinder.

Name of representative: Toshio Nakao, Patent Attorney, and 1 Other.

Fig. 1

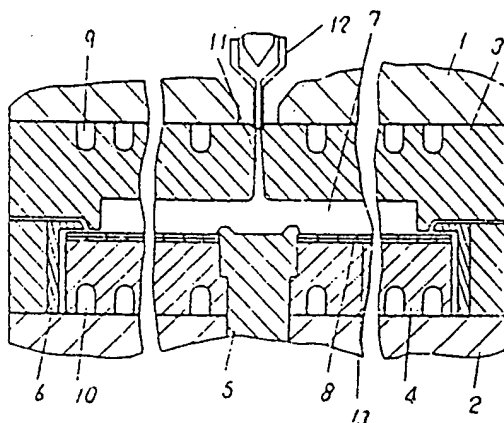


Fig. 2

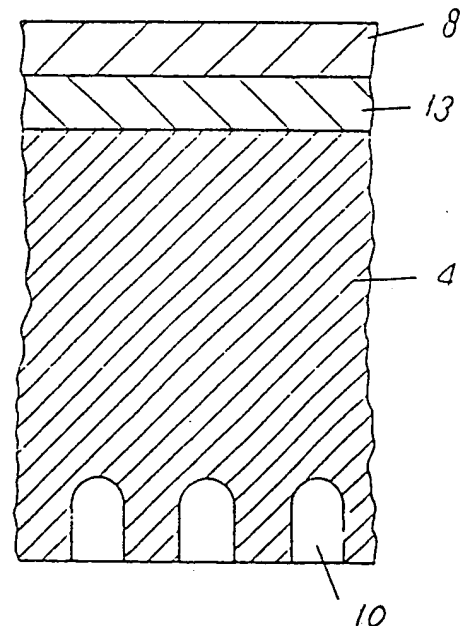


Fig. 3

